B8

while the outermost polyurethane layer 25 is pigmented black. The polyvinylfluoride layer 26 forming the exterior of the laminate 17 is pigmented white and thus forms the external appearance of the laminate.

REMARKS

During a recent review of the parent application several typographical errors were discovered. The above amendments correct these errors. This amendment does not affect the scope of the claims. No new matter is added by these amendments. A marked-up copy of these amendments is submitted concurrently herewith as required by 37 CFR § 1.121.

Respectfully submitted,

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CERTIFICATE OF FACSIMILE TRANSMISSION

I hereby certify that this correspondence is being transmitted by facsimile to the Assistant Commissioner for Patents at Fax No. 703-872-9310 on March 18, 2002.

18 MARCH 2002

Date

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09/927,034
Filed 8/9/2001
Page 7

Marked-up Amendments as Required by 37 CFR § 1.121

Paragraph beginning at page 3, line 11

In heavy load cargo airship applications, however, fabrics the same as or similar to the Mater '558 patent tend to form the woven fabric which is thick and bulky. If typical industrial polyester fiber is used the strength of the fiber and the demand of these large airships leads to a very large yarn of perhaps 6-10,000 denier. The alternates is to use high-strength synthetic materials such as aromatic polyamides, one example of which is available from DuPont under the Kevlar® trademark or liquid crystal polyester (e.g., Vectran®) in the form of highly twisted yarns in a plain woven structure (e.g., U.S. Patents Nos. 5,837,623 and 5,565,264). Even if the fibers have [tenacitys] tenacities of 20 grams per denier the yarns required become thick and bulky with the typical twist levels. Because of these strength requirements for the hull material, the yarns, and thus the weave, are typically formed very thick. In turn, the amount of polymer used to fill in the weave in order to provide both adhesion and the gas barrier tends to be quite high. Stated differently, the use of big, bulky high-strength, high-twist yarns produces a relatively thick woven structure which requires a large amount of polymer (typically polyurethane) to seal it. As a result, the hull materials formed from bulky yarns, bulky weaves, and thick polyurethane coatings tend to have a weight of about 35 ounces per square yard. Although such a material is certainly "lightweight" in conventional terms, an airship of practical cargo or passenger carrying capability will include thousands of square yards of such material. For example, an airship or aerostat with 40,000 square yards of skin would include almost 88,000 pounds (almost 44 tons) of laminate material. Accordingly, reducing the weight of the hull material is one way to reduce the overall weight of the entire airship on a proportional basis. Nevertheless, given the safety requirements for both cargo and passengers that are required before a commercial airship can be put into use, the strength requirements for the hull material cannot be compromised.

Paragraph beginning at page 7, line 1.

The yarns in the fabric of the present invention have sufficient twist to provide the desired [textile] tensile conversion, but less than the amount of twist that would produce unsatisfactory thick and heavy fabric. Thus, in a numerical sense, using a 1500 denier yarn of 1.4 specific gravity, yarns of this description are considered to be "low twist" which is typically taken as being a twist of less than about 240 turns per meter, or less than six (6) turns per inch. Again using the 1500 denier example, twists of less than 118 turns per meter and less than three (3) turns per inch, and in some cases less than one (1) turn per inch, are most preferred. The helix angles achieved with this yarn represent the design factor. As in all twist calculations the twist must be adjusted based on denier to achieve a consistent helix angle.

Paragraph at page 7, line 19.

"Flex fatigue" is used herein to refer to the characteristics of the laminate with respect to bending stress loading. In this regard, its use is very similar, and perhaps identical depending upon the circumstances, to the use of the term "fatigue testing" with respect to metals and other materials. A material can fail (*i.e.*, break or suffer irreversible degradation of tensile properties) after repeated stress loading even if the stress level never exceeds the fundamental strength limits of the material. The behavior of materials under repeated stress loading is typically evaluated by fatigue testing. In one form, a specimen is loaded repeatedly to a specific stress amplitude, and then the number of applications or repetitions of that stress that are required to cause failure is counted. Round specimens such as metal bars or rods are typically stress tested using rotational tests, but alternating deflection, or bending tests are more common for sheet materials such as the laminates of the present invention. When these large airship fabric assemblies are [build] built, inflated and deflated the fabric is folded or bent on itself. Those of ordinary skill in a number of arts are familiar with the

concepts of bending flex fatigue and fatigue testing. A relatively straightforward exemplary discussion is given, for example, in Lindeburg, *Engineer-in-Training Reference Manual*, 8th edition, Professional Publications, Inc. (1996) at pages 36-8 and 36-9.

Paragraph at page 8, line 19.

Generally speaking, starting from no twist whatsoever, the flex fatigue performance of a fabric made from twisted yarns increases with the amount of twist. It has now been discovered, however, that in airship laminates according to the present invention, the relationship between flex fatigue and twist is bi-modal in its characteristics. Figure 6 illustrates this in graphical fashion in which flex fatigue performance is plotted against twist. The results are shown in a general (rather than specific) pattern that has been observed in connection with the present invention. Thus, conventionally yarns have been twisted to the degree defined by the zone B in Figure 6, which requires a higher degree of twist, and therefore a higher weight in the resulting laminate. The present invention, however, operates in the lower twist zone indicated at A in Figure 6. It is expected that this zone has improved flex fatigue because the thinner structure keeps [the] more of the fiber near the low stress area in the bent laminate. As the yarns get rounder the fabric is thicker and the tensile and compressive stress on the inner and outer fiber go up rapidly. More stress for a given bending angle leads to greater strength loss per bending cycle and hence less flex performance. The conventional twist approach while improving the flex fatigue of the base yarns also subjects them to a more damaging condition because of increased thickness.

Paragraph at page 9, line 14.

In turn, tear strength, represents the ability of the material to resist rupture by tearing. Tear strength is measured by the force required to start or to continue a tear in a fabric under specified conditions. In the case of airship materials the specific tear geometery of importance is the slit tear. In testing, the material is subjected to a two-dimensional stress field. If the laminate is damaged in a collision, a slit or opening can be made in the laminate.

The damage or slit in the material must not tend to grow under [to] a stress field. If the slit grows the overall integrity of the airship could be put in question.

Paragraph at page 10, line 26.

Crossing points refer to any positions where yarns cross over one another. To be considered to be a crossing point the yarn must cross to the opposite side of the nearest yarn. These are also referred to in some circumstances as "locking points." A plain weave or a full knit has the greatest number of crossing points, with other types of weaves or knits having progressively and proportionally fewer. When yarns or fibers have zero crossing points (for example, as in U.S. Patent 3,159,530 to Struble [the Struble '530 patent noted above]), the adhesive powers of the polymers in the laminate have to do all the work of holding the fabric together. In one sense, a lower number of crossing points per unit area tends to increase tear strength because it allows the filaments or fibers to slide together and resist tear, while the crossing or locking points tend to fix yarns in place where they must (and will) tear, rather than merely slide, at a specified load. From a theoretical standpoint, the fabric should have the fewest crossing points that still give the fabric sufficient integrity to allow the fabric to be handled and processed as the laminate is formed.

Paragraph at page 11, line 19.

In evaluating the strength ratio, it has been determined that strength ratios less than about 1:[36] 8 tend to represent fiber groups that are too small to give tear performance of the degree required in airship applications. At the other end of the range, it has been determined that for strength ratios greater than 1:[8] 36, the individual fiber groups are too large to give the desired materials weigh or flex fatigue performance.

09/927,034
Filed 8/9/2001
Page 11

Paragraph at page 12, line 18.

The polymers for the laminate (e.g., polyurethane) [, (] <u>are</u> commercially available<u>.</u> [conventionally] <u>Conventionally</u>, and for reasons of visibility and other purposes, the first gas barrier layer 21 is pigmented to a dark color, preferably black. The other polyurethane layer 23 that faces the woven fabric 20 is likewise pigmented black. Polyester layer 24 is typically unpigmented, while the outermost polyurethane layer 25 is pigmented black. The polyvinylfluoride layer 26 forming the exterior of the laminate 17 is pigmented white and thus forms the external appearance of the laminate.